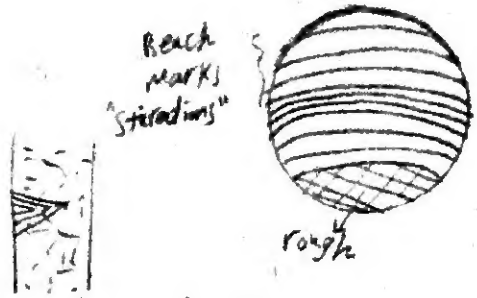
a) Intrinsic: conductivity, strength, elastic Modulus, recycling.

Attributive: Transparency, surface finish, price.

b) Beach Marks $\longrightarrow$ crack initiation area & Propagation.

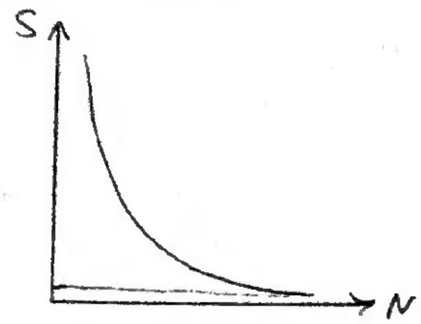
rough area $\longrightarrow$ fracture failure due to high stress.



c) S-N curve: relation between fatigue stress & No. of cycles.

fatigue limit: stress at which material can sustain infinite no. of cycles.

endurance limit: Stress at which Material can sustain infinite No. of cycles



d)

مش عليا :)

e) $U = \frac{1}{2} P \Delta$

$\boxed{\Delta = \frac{PL}{EA}}$; $\sigma = P/A \Rightarrow \boxed{P = \sigma A}$

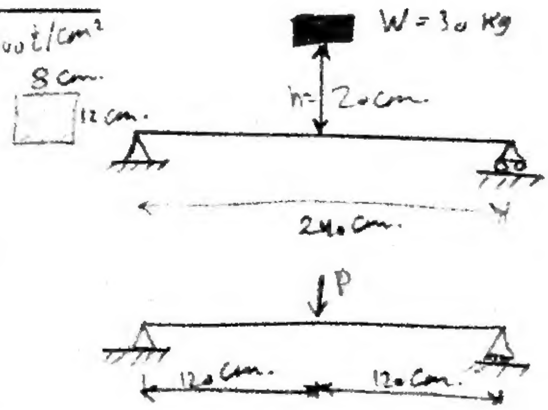
$U = \frac{1}{2}(\sigma A)\left(\frac{\sigma A L}{E A}\right)$

$\boxed{U = \frac{1}{2} \frac{\sigma^2 A L}{E}}$

ex. Moving elevator at speed "ϑ". If the wire get jammed suddenly, there is stress will be found where $U = \frac{1}{2} m \vartheta^2$, which may make the wire fail so if the wire was taller or has a wide cross section area or small Modulus of elasticity.

f) $\sigma = \frac{M}{I} y$

$E = 2000 t/cm^2$



$M = \frac{PL}{4}$, $I = \frac{8(12)^3}{12} = 1152 \text{ cm}^4$

$\sigma = \frac{P(240)(6)}{(1152)(4)} = \frac{5}{16} P$

$\boxed{P = 3.2 \sigma}$

$\Delta = \frac{PL^3}{48 EI} = 1.25 \cdot 10^{-4} P = \boxed{4 \cdot 10^{-4} \sigma}$

$W(h + \Delta) = \frac{1}{2} P \Delta$

$30(20 + 4 \cdot 10^{-4} \sigma) = \frac{1}{2}(3.2\sigma)(4 \cdot 10^{-4} \sigma)$

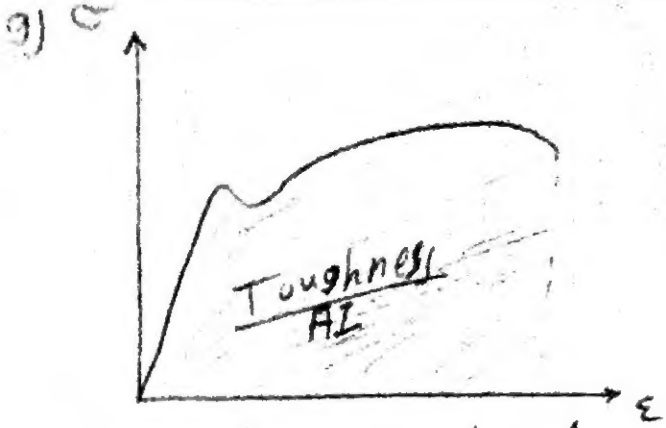
$\boxed{\sigma = 977.66 \text{ Kg/cm}^2}$

$\boxed{\Delta = 0.391 \text{ cm.}}$

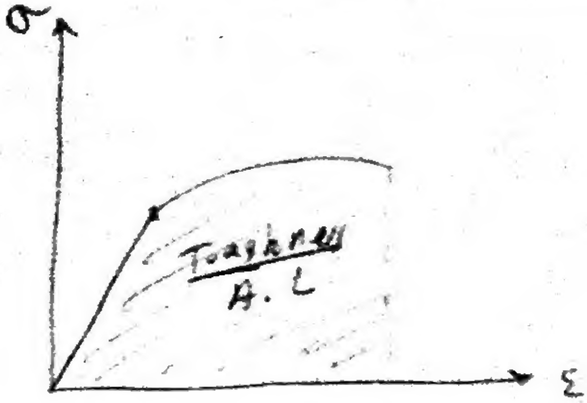
$P = 3128.512 \text{ Kg}$

$\boxed{K_d = \frac{P}{W} = 104.283}$

The value of falling weight can be increased by: 1) rotating the beam 90°.
2) Increasing the hieght "h".

g) 

Ductile material



Brittle Material

i) $\boxed{A = 1.12\ cm^2 \quad l_o = 120\ mm}$

① $\sigma_y = \dfrac{P_y}{A} = \dfrac{3.136 \times 10^3}{1.12} = 2800\ Kg/cm^2$

$\sigma_u = \dfrac{P_u}{A} = \dfrac{5.6 \times 10^3}{1.12} = 5000\ Kg/cm^2$

$E = \dfrac{P\,L}{\Delta\,A} = \dfrac{3.6 \times 12}{0.01935 \times 1.12} = 1993.35\ t/cm^2$

$\%\ elongation = \dfrac{\Delta_{max}}{l_o} = \dfrac{3.6}{12} \times 100 = 30\%$

② $\sigma_D = \dfrac{\sigma_y}{f.o.s}$

$\boxed{f.o.s = 1.5}$

$\sigma_D = \dfrac{2800}{1.5}$

$\sigma_D = 1866.67\ Kg/cm^2$

$\sigma_D = \dfrac{P}{A}$

$\dfrac{\pi D^2}{4} = \dfrac{30000}{1866.67}$

$\boxed{D = 4.523\ cm}$

$\boxed{f.o.s = 2.5}$

$\sigma_D = \dfrac{2800}{2.5}$

$\sigma_D = 1120\ Kg/cm^2$

$\sigma_D = \dfrac{P}{A}$

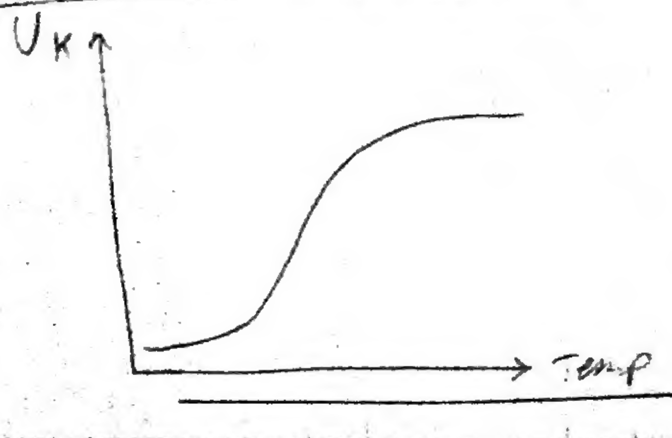
$\dfrac{\pi D^2}{4} = \dfrac{30000}{1120}$

$\boxed{D = 5.839\ cm.}$

If we use f.o.s of 2.5, we will need larger cross section which represent more material.

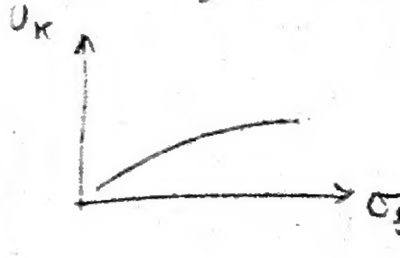
K) فتش عليها :

m) Impact energy in Charpy test & temperatures

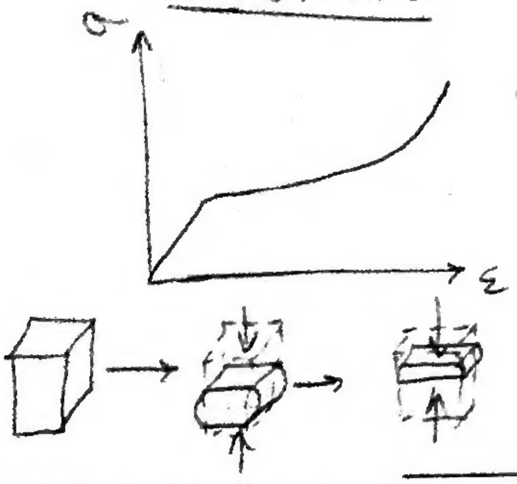


Impact energy & yield stress:

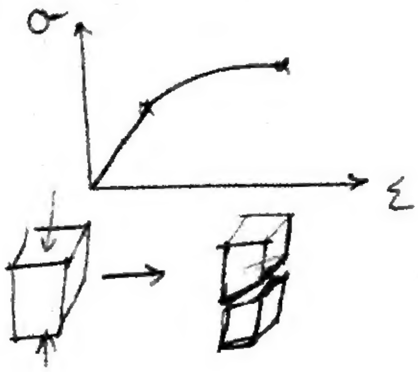
تأكد منها



a) Ductile material



Brittle material



b) Indetation hardness test, rebound hardness test "suitable to ceramic Materails"; scratch hardness test, wear hardness test, Machineability hardness test.

c) $$HB = \frac{P}{\frac{\pi D}{2}\left[D - \sqrt{D^2 - d^2}\right]}$$; $\frac{P}{D^2} = 30 \longrightarrow D = 6.05\ mm$. & $d = 2.6\ mm$.

$$\boxed{HB = 197.148}$$

$$TS = 0.36\ HB = 70.973\ kg/mm^2.$$

d) (مش علينا)

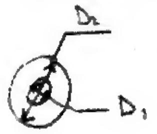
e) $L = 1.5\ m.$

$D_2 = 60\ mm.$

$D_1 = 40\ mm.$

$T = ??$

$\tau \ll 120\ MPa.$



$G = 77.2\ GPa.$

$$\tau = \frac{T}{I_p} c$$

$$T = \frac{\tau\ I_p}{c}$$

$$T = \frac{120 \times 1.021 \times 10^6}{30}$$

$$\boxed{T_{max} = 4.084 \times 10^6\ N.mm.}$$

$$I_p = \frac{\pi (D_2^4 - D_1^4)}{32} = 1.021 \times 10^6\ mm^4$$

$$\tau_{min} = \frac{T}{I_p} y$$

$$\tau_{min} = \frac{4.084 \times 10^6}{1.021 \times 10^6} (20)$$

$$\boxed{\tau_{min} = 80\ MPa.}$$

$$\theta = \frac{T.L}{I_p.G} = 0.077\ rad. = 4.453°$$